NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Energy Systems Integration Facility Workshop

Distribution Systems Integration

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Laboratories Discussed

- PSIL, SPL, ESL, OTA's, REDB, SCADA

Workshop Breakout Participants

- **Research labs and universities:**
  - National Energy Technology Lab (NETL)
  - University of Colorado
  - Colorado State University
- **Industry:**
  - Kohler
  - Encorp
  - Lockheed Martin
  - CenturyLink

Top Challenges

- System integration of multiple energy sources
- Microgrid development and testing
- Increase collaborations and virtual connections with other research facilities
- Smart-grid standards (UL 1741, wrt ground faults on DC input, IEEE1547, etc.)
- New visualization techniques for optimal utilization of assets
- Protective components which have bidirectional capability
- Fast-responding fossil fuel generation

Important ESIF Capabilities

- Micro-grid demonstration projects that inform R&D
- Control strategies and advanced equipment that can respond to dynamic pricing scenarios
- Test and development of dispatch strategies and communication interfaces
- Development and test capabilities in SPL to allow for combination of protocols and testing of Home Area Networks
- Community energy storage development and testing

Important ESIF Capabilities

- Interest in sequence of operations for storage and generation systems.
- Prototype testing – compliance, advanced functionality, performance, safety, etc. prior to field trial
- Capability to evaluate large backup generation systems at the outdoor test areas
- Development and testing of Combined Heat and Power

Important ESIF Capabilities

- Capability to purposely disrupt your grid, doing different mode of data acquisition to see whether recovery and self-healing can occur.
- Testing in PSIL of fuel cells together with other technologies such as generation and storage

Missing ESIF Capabilities / Suggestions

- Consider bringing in Legacy equipment and show how that equipment can work with new smart grid components
- Ability to evaluate effects of latency in communications for control stability between integrated components (may include additional requirements for cyber security communications)
- Investigate the 9 consumer behavior studies headed by Peter Cappers at Lawrence Berkeley to inform facility design (SPL)
- Consider adding class 1, class 2, and class 3 EV charging to allow for testing and research in ESIF
- Consider using ECL for developing safety systems for protective relays

Missing ESIF Capabilities / Suggestions

- Need for automatic transfer switch setups for testing with industrial customers (UL standard 1008)
- Engine exhaust and gas analysis for IC processes
- Consider and characterize back pressure on exhaust ports for engine testing (some are sensitive)
- Pay close attention to measuring and performing offline harmonics analysis with a SCADA system
- Consider adding equipment to allow for fine tuning power quality analysis
- Consider safety within laboratories and make sure they have visual indicators regarding electrical and other hazards